

CLAIMS:

1. An apparatus for extracting an obstruction located in a patient's vessel by fragmenting the obstruction and conveying fragments of the obstruction through the apparatus and out of the patient's body, comprising in combination:
 - a flexible-tube, having an open distal end, and is connectable to a negative pressure,
 - a motor-rotateable flexible conveyor-shaft that is disposed in the flexible tube
 - at least a part of the flexible conveyor-shaft is a spiral wire with gaps between its coils to enable the spiral to convey fragments, the direction of the spiral is such that as it rotates relative to the flexible tube it conveys the fragments, cooperatively with the negative pressure, from the open distal end through the flexible tube,
 - an offset agitator that at least partially extends out of the open distal end of the flexible-tube being connected to and rotated by the distal end of the flexible conveyor-shaft to fragment the obstruction while rotating with an effective diameter that is larger than its cross-sectional diameter,
 - wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire formed from flattened wire, the conveyor-shaft being made of the flattened wire wound on its edge and the offset agitator being made from the flattened wire wound on its side and wherein the conveyor-shaft and the offset agitator are connected one the other by a short section of twisted wire that is an integral part of the spiral wire that does not block fragments from entering the gaps between the coils of the

conveyor shaft.

2. An apparatus for extracting an obstruction located in a patient's vessel by fragmenting the obstruction and conveying fragments of the obstruction through the apparatus and out of the patient's body, comprising in combination:
 - a flexible-tube, having an open distal end, and is connectable to a negative pressure,
 - a motor-rotateable flexible conveyor-shaft that is disposed in the flexible tube
 - at least a part of the flexible conveyor-shaft is a spiral wire with gaps between its coils to enable the spiral to convey fragments, the direction of the spiral is such that as it rotates relative to the flexible tube it conveys the fragments, cooperatively with the negative pressure, from the open distal end through the flexible tube,
 - an offset agitator that at least partially extends out of the open distal end of the flexible-tube being connected to and rotated by the distal end of the flexible conveyor-shaft to fragment the obstruction while rotating with an effective diameter that is larger than its cross-sectional diameter,
 - the offset agitator is a spiral wire with gaps between its coils that are substantially smaller than the gaps between the coils of the flexible conveyor-shaft.
3. An apparatus for extracting an obstruction located in a patient's vessel by fragmenting the obstruction and conveying fragments of the obstruction through the apparatus and out of the patient's body, comprising in combination:

a flexible-tube, having an open distal end, and is connectable to a negative pressure,

a motor-rotateable flexible conveyor-shaft that is disposed in the flexible tube at least a part of the flexible conveyor-shaft being a spiral wire, the direction of spiral is such that as it rotates relative to the flexible tube it conveys the obstruction fragments, cooperatively with the negative pressure, from the open distal end through the flexible tube,

a clearance between the flexible conveyor-shaft and the flexible tube being large enough so that the flexible conveyor-shaft rotates freely in the flexible tube and small enough so that the flexible conveyor-shaft radially supports the flexible tube to prevent it from kinking while the apparatus operates in a curved vessel,

an offset agitator that at least partially extends out of the open distal end of the flexible-tube being connected to and rotated by the distal end of the flexible conveyor-shaft to fragment the obstruction while rotating with an effective diameter that is larger than its cross-sectional diameter.

4. An apparatus for extracting an obstruction located in a patient's vessel by fragmenting the obstruction and conveying fragments of the obstruction through the apparatus and out of the patient's body, comprising in combination:

a flexible-tube, having an open distal end, and connectable to a negative pressure,

a motor-rotateable flexible conveyor-shaft that is disposed in the flexible tube

at least a part of the flexible conveyor-shaft is a spiral wire, the direction of spiral is such that as it rotates relative to the flexible tube it conveys the obstruction fragments, cooperatively with the negative pressure, from the open distal end through the flexible tube,

an offset agitator that at least partially extends out of the open distal end of the flexible-tube being connected to and rotated by the distal end of the flexible conveyor-shaft to fragment the obstruction while rotating with an effective diameter that is larger than its cross-sectional diameter.

wherein the offset-agitator can be moved in and out of the flexible tube, through the open distal end, to adjust the effective diameter of the offset agitator.

5. As in claim 1 wherein the cross-section of an outer diameter of the flexible conveyor-shaft is larger than the cross-section of an outer diameter of the offset agitator.
6. As in claim 1 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is rounded.
7. As in claim 1 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is an integral part of the wire that has been melted to form a rounded tip.

8. As in claim 1 wherein the flexible conveyor-shaft is made from a spiral wire with gaps between its coils to enable the spiral to engage with and convey the fragments and wherein an outer surface of the offset agitator is uninterrupted to reduce its likelihood of entanglement inside the vessel.
9. As in claim 1 wherein the flexible conveyor-shaft and the offset agitator are made from a spiral wire, the gap between the coils of the flexible conveyor-shaft are substantially larger than gap between the coils of the offset agitator.
10. As in claim 1 wherein a portion of the offset agitator that comes in contact with a wall of the vessel is smooth and another portion of the surface of the offset agitator is rough.
11. As in claim 1 wherein the flexible-tube transmits light across its wall.
12. As in claim 1 wherein the flexible-tube transmits light along its wall.
13. As in claim 1 wherein the apparatus is inserted into the vessel through an introducer having an inlet port that is connected to a pressurized fluid through a flexible line and the evacuation port that is connected to the negative pressure through a flexible line, wherein the flexible lines pass through valves that shut off the flow through the

lines when the motor is selectively disabled.

14. As in claim 1 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire that define a continuous passage that can accommodate a guidewire over which the flexible conveyor-shaft and the offset agitator can slide.
15. As in claim 2 wherein the cross-section of an outer diameter of the flexible conveyor-shaft is larger than the cross-section of an outer diameter of the offset agitator.
16. As in claim 2 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is rounded.
17. As in claim 2 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is an integral part of the wire that has been melted to form a rounded tip.
18. As in claim 2 wherein the flexible conveyor-shaft is made from a spiral wire with gaps between its coils to enable the spiral to engage with and convey the fragments and wherein an outer surface of the offset agitator is uninterrupted to reduce its likelihood of entanglement inside the vessel.

19. As in claim 2 wherein the flexible conveyor-shaft and the offset agitator are made from a spiral wire, the gap between the coils of the flexible conveyor-shaft are substantially larger than the gap between the coils of the offset agitator.
20. As in claim 2 wherein a portion of the offset agitator that comes in contact with a wall of the vessel is smooth and another portion of the surface of the offset agitator is rough.
21. As in claim 2 wherein the flexible-tube transmits light across its wall.
22. As in claim 2 wherein the flexible-tube transmits light along its wall.
23. As in claim 2 wherein the apparatus is inserted into the vessel through an introducer having an inlet port that is connected to a pressurized fluid through a flexible line and the evacuation port that is connected to the negative pressure through a flexible line, wherein the flexible lines pass through valves that shut off the flow through the lines when the motor is selectively disabled.
24. As in claim 2 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire that define a continuous passage that can accommodate a guidewire over which the flexible conveyor-shaft and the offset agitator can slide.

25. As in claim 3 wherein the cross-section of an outer diameter of the flexible conveyor-shaft is larger than the cross-section of an outer diameter of the offset agitator.
26. As in claim 3 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is rounded.
27. As in claim 3 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is an integral part of the wire that has been melted to form a rounded tip.
28. As in claim 3 wherein the flexible conveyor-shaft is made from a spiral wire with gap between its coils to enable the spiral to engage with and convey the fragments and wherein an outer surface of the offset agitator is uninterrupted to reduce its likelihood of entanglement inside the vessel.
29. As in claim 3 wherein the flexible conveyor-shaft and the offset agitator are made from a spiral wire, the gap between the coils of the flexible conveyor-shaft are substantially larger than the gap between the coils of the offset agitator.
30. As in claim 3 wherein a portion of the offset agitator that comes in contact with a wall of the vessel is smooth and another portion of the surface of the offset agitator is

rough.

31. As in claim 3 wherein the flexible-tube transmits light across its wall.
32. As in claim 3 wherein the flexible-tube transmits light along its wall.
33. As in claim 3 wherein the apparatus is inserted into the vessel through an introducer having an inlet port that is connected to a pressurized fluid through a flexible line and the evacuation port that is connected to the negative pressure through a flexible line, wherein the flexible lines pass through valves that shut off the flow through the lines when the motor is selectively disabled.
34. As in claim 3 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire that define a continuous passage that can accommodate a guidewire over which the flexible conveyor-shaft and the offset agitator can slide.
35. As in claim 4 wherein the cross-section of an outer diameter of the flexible conveyor-shaft is larger than the cross-section of an outer diameter of the offset agitator.
36. As in claim 4 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is rounded.

37. As in claim 4 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire and wherein the distal tip of the offset agitator is an integral part of the wire that has been melted to form a rounded tip.
38. As in claim 4 wherein the flexible conveyor-shaft is made from a spiral wire with gap between its coils to enable the spiral to engage with and convey the fragments and wherein an outer surface of the offset agitator is uninterrupted to reduce its likelihood of entanglement inside the vessel.
39. As in claim 4 wherein the flexible conveyor-shaft and the offset agitator are made from a spiral wire, the gap between the coils of the flexible conveyor-shaft are substantially larger than the gap between the coils of the offset agitator.
40. As in claim 4 wherein a portion of the offset agitator that comes in contact with a wall of the vessel is smooth and another portion of the surface of the offset agitator is rough.
41. As in claim 4 wherein the flexible-tube transmits light across its wall.
42. As in claim 4 wherein the flexible-tube transmits light along its wall.

43. As in claim 4 wherein the apparatus is inserted into the vessel through an introducer having an inlet port that is connected to a pressurized fluid through a flexible line and the evacuation port that is connected to the negative pressure through a flexible line, wherein the flexible lines pass through valves that shut off the flow through the lines when the motor is selectively disabled.

44. As in claim 4 wherein the flexible conveyor-shaft and the offset agitator are a continuous spiral wire that define a continuous passage that can accommodate a guidewire over which the flexible conveyor-shaft and the offset agitator can slide.

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